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ABSTRACT

This document contains 4 issues (spring 2002-winter 2002-2003) of "WCER Highlights," a publication of the Wisconsin Center for Education Research (WCER). Topics covered by the articles include: new tools for educational data management; the practice of science; the FAST (Families and Schools Together) program; South African students meet U.S. peers; testing accommodations; better teacher evaluation practices; services provided by Comprehensive Regional Assistance Centers; educational equity for deaf and hearing students; 30 years of mathematics education research; measuring effects of systemic initiatives; new NSF (Nation Science Foundation) research centers at WCER; a home-grown professional development program succeeds; measuring the content of instruction; "academic enablers" and student success; putting case study results into context; and developing algebraic reasoning in the elementary school. (MES)

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WCER Highlights, 2002-2003

Paul Baker, Editor

WCER Highlights v14 n1-4 Spr 2002-Win 2002-2003

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WCER Highlights

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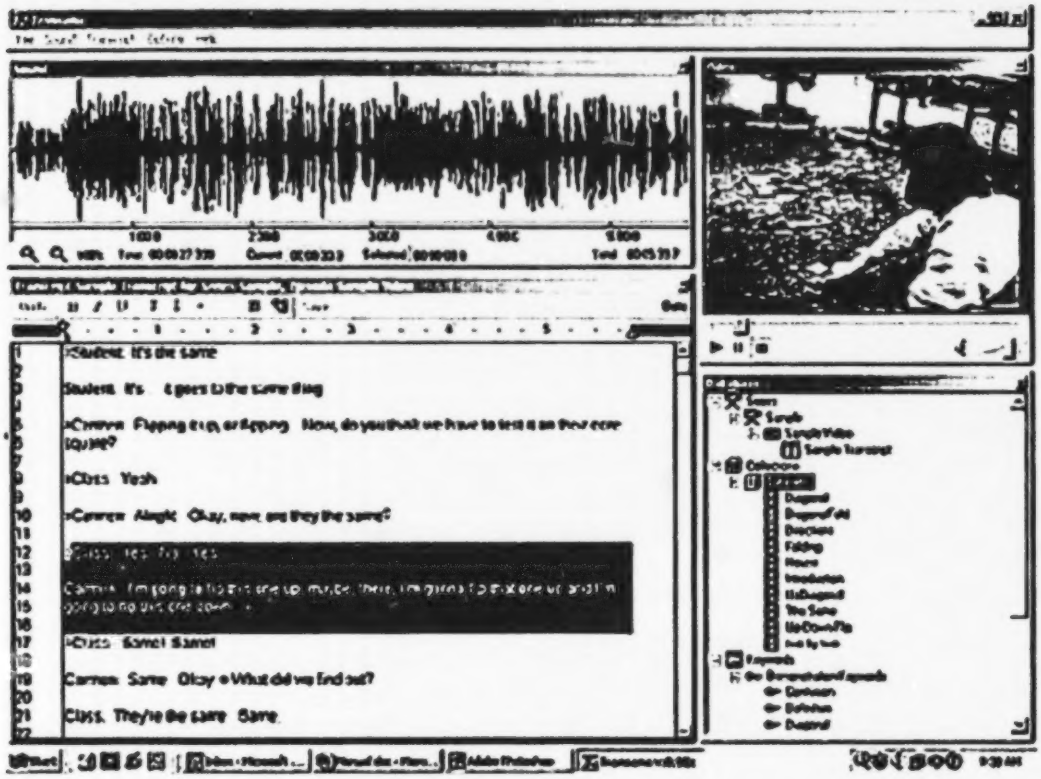
New tools for educational data management



Transana software helps support researchers studying teacher-student interactions to build histories of student learning.

Video data is an increasingly important resource for education researchers. High-profile studies such as the Third International Mathematics and Science Study–Repeat (TIMSS-R) showcase digital video of classroom practices as a central element of their research.

Designers of new curricula and professional development materials are creating high-impact multimedia content that is based on rich studies of classroom practices.

Video data can be more fully utilized when archived in digital format, well catalogued, and readily accessible. WCER's Christopher Thorn and colleagues have developed tools to help educators and researchers more effectively use digitized video data and other forms of related evidence. Thorn's project, *Digital Insight*, supports researchers as they acquire, manage, analyze, and disseminate video-based historical accounts of learning and development.[1]

WCER Highlights

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FROM THE DIRECTOR

Networking

Building networks is an important part of life and learning. In this issue of *Highlights* you'll read about a collaborative program in science and mathematics education in which South African doctoral students network with peers in U.S. universities. The doctoral students report their experiences have helped them complete important research tasks, to think about the implications of their research, and to make breakthroughs in significant problems they had previously been unable to solve.

To become scientifically literate, students need a knowledge of scientific practice as well as science content. WCER researchers are working with ninth graders and their teachers to learn about science as it is actually practiced. This perspective marks a shift away from the view of science as a largely descriptive enterprise and toward the view that *explanation* is a central goal of scientific work.

A program called Families and Schools Together (FAST) is enhancing children's academic and social performance by strengthening networks among parents, schools, and the community. Created in Madison, the program is now in practice in schools nationwide and in foreign countries. Students who have participated in the FAST program experience fewer behavioral problems and show improved academic performance.

And to consider the technological side of networking: Designers of new curricula and professional development materials are creating more high-impact multimedia presentations. These materials can be better used when they are archived in digital format and stored on servers, well catalogued and readily accessible. Our cover story explains tools that help educators and researchers more effectively acquire, manage, analyze, and disseminate video-based historical accounts of learning and development.

For more information about these stories and other research, visit our Web site at www.wcer.wisc.edu.

Andy Porter

Thorn

Analyzing and annotating analog video is time consuming. But new video management software being developed by the *Digital Insight* team supports participants throughout the research process. *Transana*, for example, allows researchers to study much more data in the same time it would take to analyze a handful of data sets of analog video. The *Digital Insight* research environment also allows for more sophisticated analysis and for sharing results with researchers at a distance.

The *Digital Insight* project is also designed to help researchers bring more forms of data to bear on a problem and to make new arguments. It addresses the challenges researchers face in

- video management,
- human subject protection,
- data management, and
- use of archived multimedia data for secondary analysis and teaching.

Researchers can extract event-based data—such as an instance of teacher-student interaction—from video observations. These events can then be correlated with other kinds of data, such as field notes, images of student work, lesson plans, and assessment data. The goal is to build rich histories of student learning and development.

The first product of the *Digital Insight* team is a video transcription and analysis tool called *Transana*, now available at http://www.transana.org/. *Transana* was originally designed by Thorn's colleague Chris Fassnacht to support his own dissertation research.

Transana provides a way to view video, create a transcript, and link portions of the transcript to frames in the video. It facilitates identifying and organizing analytically interesting portions of videos and attaching keywords to those video clips. It also features database and file manipulation tools that help researchers organize and store large collections of digitized video.

More specifically, *Transana* allows users to

- import and view MPEG–1 videos;
- create transcripts of the videos;
- navigate through videos using several different mechanisms, including a graphic of audio soundtracks;
- link frames in the video to positions in a transcript by embedding video time codes in the transcript;
- automatically highlight the relevant portion of the transcript while the video plays;
- select analytically interesting portions of the video, which can be grouped;
- define keywords and apply them to portions of video;
- search for instances of keywords and see the video clips to which they have been applied; and
- transfer video files to and from a storage resource broker (SRB), a computer system with massive storage capacity.

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The practice of science

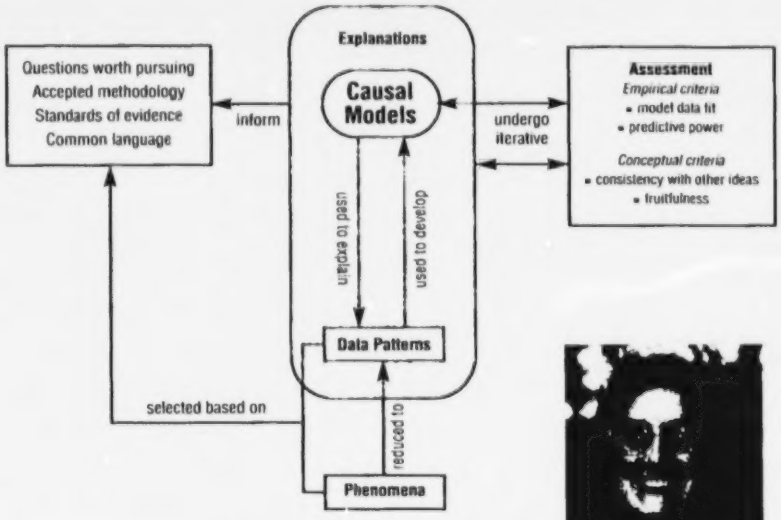
By the time they get to high school, students have had at least 9 years of learning to play the "game" of school. They know what it takes to win: Just give the right answer. In the field of science, this approach places undue emphasis on the end products of scientific inquiry, depriving students of the opportunity to learn about the *practices* through which scientific theories and explanations are constructed.

Fortunately, instruction can be reorganized to dramatically change the nature of the school game. In new instructional contexts, students participate in making and assessing knowledge claims. They learn to recognize these activities as necessary to achieving understanding in science.

Jennifer Cartier, Cynthia Passmore, and James Stewart argue that a knowledge of scientific practice is an important part of becoming scientifically literate. Cartier, Passmore, and Stewart are part of a team of university researchers and local teachers known as MUSE (Modeling for Understanding in Science Education), headquartered at WCER's National Center for Improving Student Learning and Achievement in Mathematics and Science (NCISLA).[1] They have articulated a view of classroom understanding that is consistent with science as it is actually practiced.

The *practice framework* designed by MUSE (see illustration) recognizes essential elements of inquiry, yet is general enough to be useful in classrooms. The framework shows the central role of *models* in asking questions, recognizing data patterns, constructing explanations, and providing the criteria for judging knowledge claims.

Cartier and colleagues say this framework reflects a recent shift away from the view of science as a largely descriptive enterprise. The current view holds that *explanation* is a central, if not *the* central, goal of scientific endeavor. "Scientific inquiry is fundamentally about reducing the world to order," Passmore says. "Those reductions take the form of explanations." Inquiry in science is of primary importance. In fact, the MUSE team has identified *the ability to participate in inquiry* as an essential component of understanding in science.



The MUSE Practice Framework

Models in scientific practice

Most often explanations involve the intersection of some *causal* model, or models, with data from the natural world. A scientific explanation is a careful mapping of a model to data. For example, an explanation for why we see phases of the moon describes the movement of the Moon relative to the Earth and Sun (a model of celestial motion). This model results in the predictable data pattern of phase changes throughout the month.

In some cases, models themselves become the objects of inquiry. When a new question is asked—for example, does light always behave as a wave? does genetic drift account for evolutionary changes in some species?—scientists assess existing models to see if they can address the question. If they cannot, scientists revise the existing models or develop new ones.

Engaging students in exploring phenomena (such as the phases of the Moon) and developing or invoking models to account for those phenomena is a powerful way to get students started in classroom inquiry. As students explore specific phenomena, they participate in practice by developing explanations and beginning to formulate their own questions. Students' questions are often quite sophisticated. For example, one student participant in MUSE research learned about the phases of the Moon by exploring local data. Then the student asked whether the same pattern would be visible from the southern hemisphere. This prompted him to gather information, print and electronic, to answer the question. In this case, the student was probing the fruitfulness of his model.

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Cartier

Passmore

Stewart

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FAST strengthens families

McDonald

Recent school violence has shattered the public's perception that their children are safe. The roots of violence can often be traced to the family and the neighborhood. Parents are often too busy to spend time with their children, and neighbors do not know one another. Stretched thin by the demands of work and family and struggling to survive economically, parents find less and less time to socialize with other parents. The recent book *Bowling Alone* by Robert D. Putnam (Simon & Schuster, 2000) documents the deterioration of friendships and other reciprocal relationships—*social capital*—in U.S. communities. People in schools and communities risk health and safety without the protection of networks of trusting relationships. Without social support, parents cannot provide enough support for their children as they face developmental stresses. Without caring parents, youth move toward dark futures of school failure, delinquency, drug and alcohol abuse, and even violence.

To prevent these root causes from taking hold, WCER Senior Scientist Lynn McDonald initiated a school and community program in 1988 called Families and Schools Together (FAST). McDonald developed the FAST program to enhance children's academic and social performance. FAST programs build relationships among parents, schools, and the community. Multiple families from a school gather once a week for 8 weeks to share a meal and participate in a variety of structured social activities, including music, drawing, family games, children's sports, and opportunities for parents to interact in activities that apply theory and research. Students who have participated in the FAST program experience fewer behavioral problems and show improved academic performance.

To prevent violence and delinquency, McDonald says, it's important to work with younger children and their family networks. Early in children's lives, protective factors can make a big difference in development. Children in kindergarten and first grade are at an ideal age, and schools are an ideal location for intervention, with families having a central role. "All kindergarten children should have the chance to go to FAST," McDonald says.

This past winter saw the completion of four multiyear research studies that used randomized trials to assess the impact of FAST. The studies evaluated the multicultural FAST program in 9

A recent $1.9 million grant has enabled the launch of FAST as a major national initiative.

New Orleans schools, 10 inner-city Milwaukee schools, 3 rural Wisconsin schools serving Native Americans, and 9 Madison schools. The results of these studies are consistent: More than one year after FAST, teachers and parents report FAST children show a statistically significant decrease in mental health indicators of risk for negative outcomes when compared with control group children. In some instances, the control group children showed significant increases in behavioral problems over time, compared with the FAST children.

If a family attends one FAST meeting, there is an 80% chance the family will graduate from the full 8-week program. This high retention rate is unusual, especially for stressed, low-income families. Two years after graduating, 86% of parent participants report that they are still seeing friends they made through FAST. Parents become friends and support one another over time. Some become community leaders. Using schools as community-based structures helps create outreach to families and becomes a viable approach for national replication.

The growth of FAST

At WCER, McDonald directs the national dissemination of FAST. The program has been disseminated to more than 600 communities in 38 states, 4 Indian nations, and 5 other countries. A recent $1.9 million grant from the Bureau of Justice Assistance, U.S. Department of Justice, has enabled the launch of FAST as a major initiative, ensuring the quality of replicating this evidence-based model.

In June, FAST officially became a Model Program for the Center for Substance Abuse Prevention (CSAP) at a ceremony at the National Press Club in Washington, D.C. Wisconsin was just awarded a federal State Incentive Grant ($3 million annually for 3 years) to disseminate CSAP Model Programs across Wisconsin. The Wisconsin Department of Health and Family Services has been designated to administer the grant.

Recognizing the program's success, U.S. Health and Human Services Secretary Tommy G. Thompson said:

"Communities across the country should insist upon and work toward excellence in helping children to succeed at school and at home, reduce drug and alcohol abuse, and reduce stress and social isolation. Families and Schools Together (FAST) and other programs supported by the federal government have shown that prevention is possible and models of excellence are available."

The state of Wisconsin allocated FAST $1 million annually from 1990 to 2000, and in 1994 then Governor Tommy Thompson was recognized by Harvard University and the Ford Foundation's Innovations in American Government awards competition for that statewide FAST initiative. Now four other states have statewide FAST initiatives. With the support of Senator Herb Kohl (D-Wis.), FAST has received national recognition and federal research and development support since 1991.

Family games and family meals at the school help build networks of parents.

Bipartisan political support and funding from the United Way, foundations, local and state governments, and the federal government have helped FAST grow over time. In September 2000, McDonald was awarded a grant for work in Moscow by the National Institute on Drug Abuse, U.S. National Institutes of Health, through the U.S.-Russia Competitive Program. Eleven FAST families graduated in Moscow in December 2001, and McDonald visited there to conduct FAST training this spring. She also received a grant for adapting FAST to work with Hmong immigrant students and their families in Madison, Wisconsin, in conjunction with the United Refugee Services, this grant was awarded by the Center for Mental Health Services, U.S. Department of Health and Human Services.

In addition to her duties as WCER Senior Scientist, McDonald is a part-time faculty member at Madison's Edgewood College in the Graduate Program in Family Therapy, and is president of the board of directors of the nonprofit FAST International, which maintains quality assurance for the dissemination of FAST with certified trainers.

For more information, contact McDonald at mrmcdona@facstaff.wisc.edu or visit the FAST Web site at www.wcer.wisc.edu/FAST.

South African students meet U.S. peers

Students from South Africa attended a seminar with peers from Howard University in Washington, D.C.

South African science and mathematics education doctoral students studying at U.S. universities in 2001 report that their U.S. work has helped them make progress in their research.

A collaborative program was begun in 1997 to develop links between South African and U.S. science and mathematics education researchers on topics of mutual interest. One aspect of the program was the support of doctoral student education. UW–Madison Education Professor Peter Hewson oversees the U.S part of the program, which is jointly funded by the U.S. National Science Foundation and the South African National Research Foundation.

Last year, 10 doctoral students who were registered at South African universities spent 2 to 4 months at selected universities in the U.S. They report that their experiences helped them progress in their graduate work in three ways: time for intensive study, access to more resources, and opportunities to share their work and receive feedback from their peers.

More time for thought

The doctoral student program in science and mathematics education was conceived to serve several purposes. First, since South African students typically do their doctoral work part-time, the visit to the U.S. aimed to give them an opportunity to focus exclusively on their doctoral research. The idea was that intensive study of this nature would permit them to make significant progress in both conceptualizing and analyzing data for their dissertations. Second, the research capacity of their host institutions in the U.S. provided them with access to significant resources, both human and material, for furthering their research. The program matched students with faculty mentors who shared their research interests and also gave them access to other faculty members, graduate students, courses, library holdings, and the like. Third, the South African students presented their work to audiences with interests and perspectives different from their own, which helped them clarify their

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own research and provided them with confidence that their work represented a contribution to the field. Additionally, their participation in the academic life of their host institutions and departments helped to enrich and broaden the dialogue and perspectives of their peers.

The South African students took advantage of their host institutions' material resources, such as the journals, books, and online materials available through these institutions' libraries. Students reported that these resources helped them broaden their literature review, learn new methods of data analysis, and clarify issues in their research.

Students also appreciated the opportunity to attend lectures, courses, seminars, workshops, and conferences. Students attended courses on a variety of topics, such as science and mathematics education, discourse analysis, research methods in education, teaching for understanding, professional development, and the history of mathematics.

Students received critiques of their work, both individually from faculty members and collectively from other graduate students. This feedback helped them clarify their thinking and sharpen their research focus, while also providing support, motivation, and encouragement to move forward with their doctoral work. Students reported that the feedback they received was especially affirming when it indicated that the work they were doing was of interest, importance, and relevance to others in their fields of study.

The program also offered the South African students the opportunity to participate in a day-long seminar with graduate students from Howard University, a historically black university in Washington, D.C. The purpose of this facet of the program was to enable the students to explore the common ground between Howard's unique history in the U.S. and its research focus on oppression, on the one hand, and the South African students' research topics, on the other. Students affirmed the value of meeting students at Howard University and presenting their dissertation work in the day-long seminar. In particular, they appreciated the opportunity to discover the commonality of educational issues addressed and the diversity of the approaches adopted in studying them.

Hewson

The next step

So what happens to the students in this program when they return to South Africa? What factors will influence their ability to capitalize on their experience? According to Hewson, the hope is that the students have returned with an enhanced understanding of their research projects, a broadened set of professional contacts, and the personal motivation and initiative to complete their doctorates and move on in the development of their research expertise.

At the same time, it must be recognized that, for the most part, the students will have returned to work environments where research capacity remains limited. Ongoing responsibilities in students' home institutions could limit their future research contributions. Thus, an important factor in their future development as researchers will be the availability of support, whether provided by their own institutions or by public or private granting agencies.

For more information, contact Peter Hewson at pwhewson@wisc.edu.

Data management

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One way in which *Digital Insight* overlaps with the interests of related scholarly communities is Thorn's work with the TalkBank Project.[2] Funded by NSF, TalkBank aims to create a distributed, Web-based data archiving system for transcribed video and audio data on communicative interactions. Thorn and his technical development team are working to develop model video annotation tools that support collection building and cross-disciplinary analysis.

TalkBank's goal is to foster fundamental research in the study of human and animal communication. Thorn's colleagues are developing standards and electronic tools for creating, searching, and publishing video data via networked computers. Six disciplinary groups make up the project's initial focus: Animal Communication, Classroom Discourse, Linguistic Exploration, Gesture and Sign, Text and Discourse, and Technical Development. Other disciplines will participate as the project grows. *Digital Insight* team members are active participants in several of these areas.

For more information, contact Thorn at cthorn@wcer.wisc.edu or visit the project Web site www.talkbank.org.

Fassnacht

1. *Digital Insight* is funded by the National Science Foundation through both the National Partnership for Advanced Computational Infrastructure at the University of California–San Diego and the TalkBank project at Carnegie Mellon University.
2. TalkBank is funded by the National Science Foundation and Carnegie Mellon University.

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Practice of science

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The MUSE team designed and implemented an introductory unit for ninth graders at a local, suburban Midwestern high school. The teachers used the unit to set the stage for the whole school's science sequence. One of the more complicated phenomena the students attempted to explain was that of the seasons. They identified several seasonal data patterns including the midday angular height of the Sun, average temperature, maximum shadow length, and average day length. The students found that all these patterns depended on both time of year and global location. The students were able to make sense of this complicated set of data with their teachers' help. The MUSE practice framework helped teachers redirect the students when necessary and focus their attention on creating *explanations* for patterns in nature, rather than simply attempting to offer the "right answer."

The MUSE view of scientific practice as it occurs in classrooms may have important implications for the reform efforts under way in the U.S. If the goal of "understanding for all" is to be achieved, science educators must recognize that understanding in science develops through practice. Educators must design classrooms where realistic practice can happen. As a community, educators can go beyond a simple call for inquiry in science classrooms to a clear vision that can guide curriculum and professional development.

For more information, contact Cartier at jcartier@facstaff.wisc.edu or Passmore at cmpassmo@students.wisc.edu, or visit the MUSE Web site at www.wcer.wisc.edu/ncisla/muse.

1. Research is funded by the National Science Foundation and the Office of Educational Research and Improvement, U.S. Department of Education.

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Some closer looks at testing accommodations

Four recent studies shed some light on the effects of accommodations on students' test scores.

Recent education reform efforts require high standards for all students. The inclusion of students with disabilities in statewide assessment systems is now required by law and considered to represent a key aspect of good testing practices. From social and accountability perspectives, this inclusion of students with disabilities is highly valued, especially when their test scores are known to be valid. Unfortunately, many students with disabilities receive testing accommodations of unknown validity.

Including students with disabilities in assessment is important for two reasons:

1. it is critical to improving the quality of the educational opportunities available to these students, and
2. it provides meaningful and useful information about students' performance to the schools and communities that educate them.

Inclusion raises important questions, however. How appropriate are common performance standards for students with disabilities? What accommodations should be used? What are the effects of testing accommodations on the validity of assessment? How should scores be reported when accommodations have been used?

WCER Highlights

Summer 2002
Vol. 14, No. 2

4 Better teacher evaluation

6 Comprehensive Centers offer 'silent service'

7 Educational equity for deaf students

FROM THE DIRECTOR

The roles of standards

Standards continue to play an important role in K–12 education. In this issue of *Highlights*, you will read how standards are being used in the education of students with and without disabilities and in teacher evaluation.

In a dissertation study, graduate student Stephanie Cawthon investigated inclusion policies, such as those mandated by the Individuals with Disabilities Education Act (IDEA), that require educators to evaluate deaf students' participation in curricular content and assessment. Cawthon's results suggest that inclusive placement in the context of standards-based reform appears to result in equitable exposure to curricular content—that is, the opportunity to learn.

In a related article, Stephen Elliott, Tom Kratochwill, and their graduate students report on the effects of accommodations on test scores of students with and without disabilities across several studies. Their general conclusion is that the accommodations investigated are not resulting in valid information about student learning.

In another dissertation study, Steven Kimball studied how three school districts applied new standards for teaching—specifically, the model contained in *Enhancing Professional Practice: A Framework for Teaching*. Kimball concludes that new teacher evaluation systems are having positive effects on teaching practice. Nevertheless some problems remain. Principal among them is the need for the evaluator to have subject-matter competence.

For more information, visit the WCER Web site at www.wcer.wisc.edu.

Andy Porter

Accommodations are usually recommended in packages, rather than individually.

Education leaders at state and district levels struggle with these issues as they work to create policies for testing students with disabilities. In the past, many students with disabilities have been excluded from large-scale achievement tests. Reasons for the exclusion of students with disabilities are varied, but the most common are confusion about the use of test accommodations, concern over causing undue stress from testing, and fear that district test scores will go down.

Four recent experimental studies conducted by UW–Madison Education Professors Stephen N. Elliott and Thomas R. Kratochwill and their graduate students, with funding from the U.S. Department of Education's Office of Special Education and Rehabilitative Services, shed some light on current questions about the effects of accommodations on test scores of students with and without disabilities.

Packaged accommodations

Elliott, Kratochwill, and student Brian McKevitt conducted a study (2001) designed to

1. describe the nature of information on testing accommodations listed in students' individualized education programs (IEPs),
2. document the testing accommodations educators actually use when administering performance assessments to students, and
3. examine the effects accommodations have on the test results of students with and without disabilities.

The study found that accommodations were recommended in packages rather than individually – for example, the instructor might offer a combination of verbal encouragement, reading the directions aloud, simplifying some language, and rereading subtask directions. These accommodation packages were found to have moderate to large effects on performance assessment scores for most students with disabilities and for some students without disabilities. This increase in scores for students without disabilities raises questions about the validity of the accommodations. If changes in testing procedure affect students without disabilities in the same direction and degree as they affect students with disabilities, the changes are not truly acting as accommodations.

Constructed-response questions

Graduate student Aleta Gilbertson Schulte conducted a study supervised by Elliott and Kratochwill (2001) to determine whether accommodations on standardized tests affect students with disabilities differently than students without disabilities. The researchers predicted that accommo-

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dations would significantly improve the test scores of fourth-grade students with disabilities but not those of students without disabilities.

In fact, both groups of students improved significantly in the accommodated condition as compared with the nonaccommodated condition. Although students with disabilities benefited more than students without disabilities from accommodations on multiple-choice questions, the two groups benefited equally from accommodations on constructed-response questions.

The finding that both groups of students experienced benefits from testing accommodations on constructed-response questions indicates that the changes in test procedure may have affected both construct-relevant and construct-irrelevant variance. The interaction between accommodation group and question type could indicate that constructed-response questions are more difficult for all students and that accommodations remove barriers to these questions that are not present in multiple-choice questions.

These findings reinforce the principle that research on testing accommodations must take an individual perspective, and that all students must take the tests in both accommodated and nonaccommodated conditions if researchers are to determine whether accommodations provide valid information on student learning.

Extended time for tasks

In a dissertation study (2000), Ann Marquart examined the use of an extended-time accommodation on student scores on an eighth-grade mathematics test. Marquart found that giving students extended time to complete the test (40 minutes, rather than 20 minutes) did not have significant results for students with or without disabilities.

However, in a survey Marquart administered to students and their parents and teachers, most students reported feeling more comfortable, more motivated, and less frustrated under the extended-time condition. They thought they performed better, reported the test seemed easier, and preferred taking the test under the extended-time condition. Most teachers, but few parents indicated that a score from an accommodated test is as valid as a score from the same test administered without accommodations. Many parents, but no teachers believed that the score from an accommodated test is less valid than the score from a nonaccommodated test, and some members from both groups were uncertain. Most parents and teachers believed that if accommodations are used during test administration, those accommodations should be reported along with the test results.

Reading test accommodations

Graduate student Brian McKevitt (pictured above) studied the effects of testing accommodations on the scores of eighth-grade students on standardized reading tests, on score validity, and on teacher and student attitudes about testing (2001).

McKevitt found that the accommodations recommended by teachers did not significantly affect the test scores of students with or without disabilities. However, a read-aloud accommodation, when used with accommodations recommended by teachers, did positively and significantly affect test scores for both groups of students.

There was much individual variability in the accommodation effects. The accommodations raised the scores for 50% of all students with disabilities and 38% of all students without disabilities. Although the scores of both groups were higher with the read-aloud than without any accommodation, the read-aloud effect was not significant when the scores of groups receiving the read-aloud accommodation were compared with the scores of groups receiving only the teacher-recommended accommodations.

Elliott notes that educators who have cooperated with him and his students have rarely requested a summary of research on the effective use of testing accommodations. Perhaps they recognize there is little research on this issue, he says, "If research is going to guide practice, researchers and test publishers interested in seeing all students participate meaningfully in assessments will need to help front-line educators more," he says. They need to understand which testing accommodations are most likely to be valid and how they can go about making decisions about the validity of testing accommodations for individual students prior to testing.

For more information, visit the testing accommodations research Web site at http://www.wcer.wisc.edu/testacc/.

Elliott

Kratochwill

Better teacher evaluation practices

Statements of two teachers about expectations and input were typical across the districts. One said, "[The evaluations] are more two-way, I think. In the past, you just went in and sat down and they did the [form]. Now, I'm more of a participator in the evaluation process."

Over the last century, states and school districts have attempted to structure teacher evaluation practices to promote teacher accountability and improvement in practice. However, traditional teacher evaluation systems and repeated attempts at reform appear to have done little to enhance either accountability or practice.

Teacher evaluation systems are sometimes criticized for lacking commitment at the district or school level, using criteria reflecting narrow conceptions of effective teaching, providing inadequate feedback, and operating with perceived subjectivity.

Standards-based teacher evaluation represents one approach to addressing these problems. Standards aim to represent a common conception of instruction. Proponents of new standards-based teacher evaluation suggest that feedback and objectivity can be strengthened when an evaluation system uses comprehensive standards and rubrics, along with multiple data sources and authentic samples of teaching work, to generate discussion of instruction between teachers and evaluators. Accountability for teaching to new standards and instructional improvement may result from such systems.

UW–Madison assistant researcher Steven Kimball studied the design and operation of three district evaluation systems that use new sets of standards for teaching—specifically, the standards proposed by Charlotte Danielson in *Enhancing Professional Practice: A Framework for Teaching* (Alexandria, VA: Association for Supervision and Curriculum Development, 1996). Danielson designed her teaching framework generically so that it could be applied to various subject areas and to teachers with varying levels of experience.

The three school districts Kimball studied had made considerable investments in time and personnel resources to design, field-test, and implement new teacher evaluation systems. The systems aimed to enhance instructional accountability and teachers' professional growth. All three sites chose Danielson's framework for teaching because it

- is comprehensive and applies empirical and theoretical research,
- has multiple levels of performance defined by specific rubrics,
- represents a conception of teaching that can be agreed upon by teachers and evaluators,
- emphasizes teacher reflection and self-directed growth, and
- saves the extensive time and effort that would be needed to research and develop new unique standards and evaluation criteria.

Most of the teachers interviewed by Kimball considered their new evaluation systems substantial improvements over the prior systems. In comparison with the prior systems, the new systems established more structure, provided more opportunities for teacher discussion, and drew on more data sources for evaluation decisions. Teachers and others underscored the need for ongoing evaluator training to promote quality and consistency in evaluations.

Timing, credibility, and utility

On the surface, most teachers interviewed by Kimball appeared to have a positive view of the performance feedback they received. But when their comments were examined more closely, it became clear that they had expressed a variety of perceptions about the feedback timing, credibility, and utility, which influenced their experiences. In particular, the perceived credibility of evaluators' feedback varied, according to the teachers interviewed. Evaluator credibility was influenced by the amount of time evaluators had invested in the evaluation process and the extent to which teachers and evaluators had similar content expertise. Time constraints may have inhibited opportunities for feedback and evaluation dialogue in some cases.

Despite the increased workload associated with the new evaluation system, teachers largely saw the system standards, procedures, and outcomes as fair. Some teachers did question inconsistencies in evaluation data gathering and evaluator decisions. Increased administrator burdens, combined with insufficient training in the new systems, may have contributed to this problem.

The quality of many teachers' performance was confirmed, and they felt encouraged to continue what they were doing. Others changed some of their instructional strategies based on the feedback they received. Still others did not consider the feedback particularly useful but nonetheless altered aspects of their instruction after reflecting on their performance in relation to the evaluation standards. It was rare, however, for teachers to report substantial changes in their instructional practice as a result of their evaluation experiences, and the large majority of teachers did not see the evalua-

Teachers would benefit from having evaluators familiar with their content area.

Kimball

tion process as an incentive to seek out professional development opportunities.

Untenured teachers were more likely than more experienced teachers to report improvements in their instruction based on feedback received during their evaluations. Kimball offers some explanations for this finding: First, untenured teachers were often novices with little classroom teaching experience. Many new teachers struggle with the most basic (yet important) aspects of teaching: lesson organization, record keeping, and classroom interactions. Principals and other evaluators were often able to draw on their prior teaching experience and their work as instructional leaders to provide constructive feedback on these practices that novice teachers could put to immediate use.

Second, evaluators were required to spend more time with untenured teachers, observing more of their classroom sessions and conducting more pre- and postobservation conferences. The additional time evaluators devoted to assessing untenured teachers gave these teachers more opportunity for direct and ongoing feedback.

Based on his study, Kimball concluded that each of the three districts could benefit from addressing three fundamental questions related to the implementation of standards-based teacher evaluation reforms:

- Can other evaluators, besides the school-based administrators, provide effective evaluations?
- How does one strike a balance between making valid decisions about performance, on the one hand, and minimizing evaluation burdens, on the other?
- What is the appropriate amount and nature of evaluator training?

In the districts studied, administrators who traditionally conducted teacher evaluations (primarily principals) were chosen to implement the new evaluation systems. As a result, some teachers were evaluated by administrators with little or no experience in the teachers' content area or grade level. This problem was most common at the high school level, given secondary teachers' greater specialization in content fields.

Evaluators' own content backgrounds affect their ability to make informed inferences about the quality of teachers' instruction on specific content. Evaluators' backgrounds also may limit their ability to provide deep feedback. One solution, leading to deeper analysis and more credible feedback on content-related instruction, would be for evaluators to develop in-depth knowledge about teaching and learning in one subject.

For more information, contact Kimball at skimball@education.wisc.edu, (608) 265–6201.

Comprehensive Centers offer silent service

Cotherman

Fifteen Comprehensive Regional Assistance Centers around the country provide technical assistance, professional development services, educational materials, and distance learning to educators in their regions. Most Comprehensive Centers' customers gave the centers high ratings for the accessibility, quality, and utility of their services.[1] The Midwest regional center, the Comprehensive Center–Region VI (CC-VI) serves six states and is based at WCER. Center Director Audrey Cotherman calls the assistance provided by CC-VI a "silent service," involving practitioners thoroughly and deeply and enabling them to find their own solutions.

Congress created the Comprehensive Regional Assistance Centers in 1995 to provide quality services to schools, districts, state education departments, community members, and Bureau of Indian Affairs schools.

In the last 6 months, WCER's CC-VI staff have served 22,500 educators in North Dakota, Minnesota, Wisconsin, South Dakota, Iowa, and Michigan. CC-VI also coordinates its services with state departments of education to determine statewide needs. Principals and other administrators are involved by CC-VI in developing ways to change school cultures and to support high performance by teachers and students. CC-VI activities are funded by the U.S. Department of Education's Office of Elementary and Secondary Education.

Teachers' classroom practice benefits from research-based training.

Center mission

Before the formation of the 15 comprehensive centers, there were 46 assistance centers for different programs. Congress consolidated these centers into the 15 comprehensive centers so that practitioners could more easily find assistance. The centers were designed to provide a comprehensive approach to school improvement by focusing on whole school reform, and to view the special needs of special populations within the context of high performance for all students.

CC-VI trainers work with educators at their schools over a sustained time to improve the teaching and learning of reading or math, to train educators on how to collect and use data for decision making, and to provide assistance in forming professional learning communities.

CC-VI trainers also publish and distribute research studies, share effective ways to involve parents as teaching partners, guide schools in working toward safe and drug-free environments, and share research on best practices for teaching non-English-speaking students.

Generally, CC-VI's training programs focus on seven research-based areas: reading, math, English as a second language, the role of the principal as instructional leader, student assessment, parental involvement, and smaller learning communities.

CC-VI staff respect and use the knowledge practitioners already have. They design structures for educators to share their successes; they acquaint educators with results of education research, show teachers and principals how to implement the research in the classroom, and provide sustained rather than one-time or sporadic training, materials, and guidance.

Summer institute

Throughout the year, CC-VI staff spend most of their time on the road, visiting educators in their home districts. Each summer, CC-VI offers numerous institutes. This summer, educators participated in the Fifth Annual CGI National Institute on the UW-Madison campus.

CGI (Cognitively Guided Instruction) is a problem-solving mathematics program, developed at WCER, for students in kindergarten through Grade 3. CGI has proven effective for boys and girls of diverse socioeconomic, racial, ethnic, and language backgrounds. Originally developed and tested in Madison and Madison area schools, this

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Educational equity for deaf and hearing students

Students with disabilities, even those in mainstreamed classrooms, have historically received lower quality instruction and have often been excluded from the required curriculum.

Many classrooms now do include students (including deaf students) who traditionally would have been placed in special classes. At the same time as deaf students are increasingly integrated into diverse educational settings, national and state agencies are calling for higher standards of student achievement. Inclusion policies, such as the Individuals with Disabilities Education Act (IDEA), require educators to evaluate deaf students' participation in curricular content and assessment. However, it is not clear whether inclusive placement results in equitable exposure to curricular content—that is, equitable opportunity to learn (OTL).

UW–Madison graduate student and WCER research assistant Stephanie Cawthon recently completed a study of the access hearing-impaired students have to the standards-based reading curriculum. Her study adapted methods pioneered by WCER Director Andrew C. Porter and his colleagues to study the "enacted curriculum" (i.e., what is taught and how). The measure of the enacted curriculum developed by Porter and his colleagues evaluates the relationship—or alignment—between content standards and classroom practices in core content areas. It provides information on content coverage in both time (number of classes) and depth (level of cognitive work asked of students).

Cawthon investigated in particular how the Wisconsin state standards for reading are covered in classrooms with deaf and hearing students. Cawthon's study was unique in a couple of ways: First, by addressing standards for reading in the early elementary grades, it expanded the study of alignment to a new subject area. Second, it focused on a special education population and educational equity across classroom settings.

Cawthon asked teachers to complete a reading curriculum survey describing their instruction during the spring 2001 semester. Teachers were asked to indicate how much time they allocated to specific reading curriculum topics (i.e., plot, character, spelling, application of information from world events) and what types of learning goals they had for their students (e.g., to memorize, understand, apply, and analyze material).

Teachers in deaf-only, mixed, and hearing-only classrooms reported equitable exposure to standards-based curriculum. This is a promising result in the context of inclusive placement and standards-based reform. The IDEA emphasizes the need for a continuum of services based on the needs of deaf students. Cawthon's results indicate there is less need for concern over possible differences in OTL standards in different educational settings for deaf students.

Standards-based analyses may not capture all differences in instructional experiences.

Cawthon

However, notwithstanding Cawthon's finding of equitable OTL, it is still likely that teachers have different reading instruction strategies for different students. In other words, a standards-based analysis may not capture what are real differences in the instructional experiences of different participant groups. One way to graphically depict how instruction time is used is by constructing content maps. These figures are topographical maps that show relative "highs" and "lows" of instructional time, similar to the "mountains" and "valleys" over rough terrain. They demonstrate differences in how teachers implement standards-based curricula, and show levels of alignment with standards. Diversity in instruction from one teacher to the next is not only to be expected, but hoped for, given the range of communicative and educational needs of deaf and hearing students. Thus, differences in *how* teachers implement standards is a rich area for further research.

Cawthon's study has implications for the emerging field of alignment analysis in standards-based reform. Educators assume that higher levels of alignment to standards will result in higher levels of academic achievement on assessments tied to those standards. Yet achieving better results

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Comprehensive centers

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program has been replicated in Austin and San Antonio, Texas; Los Angeles, California; Dearborn and Lansing, Michigan; Milwaukee, Wisconsin; Prince George's County, Maryland; Bismarck and Fargo, North Dakota; Washington, D.C.; and numerous other sites. This year's institute was specially designed for teams composed of a trainer and two or more primary grade teachers. Over five days, participants learned how critical mathematical ideas develop in children and planned how to refocus instruction to build on children's natural mathematical abilities and to integrate the learning of skills and problem solving.

For more information, visit the CC-VI Web site at www.wcer.wisc.edu/CC-VI, e-mail CC-VI@mail.wcer.wisc.edu; or call 608–263–4220.

[1]To view a copy of the report "Comprehensive Regional Assistance Centers Program: Final Report on the Evaluation" (2000) point your browser to: http://www.ed.gov/offices/OUS/PES/ExecutiveSummary11.1.00.PSAcorrecteddoc.doc

Deaf and hearing

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involves a substantial number of other variables—for example, school resources, class size, teacher characteristics, student characteristics, assessment validity, and professional development. The strength of the relationship between degree of alignment and student achievement thus is modified by these additional factors and needs to be verified by current and future research.

Alignment between components of accountability measures is one proposed method of documenting the success of standards-based reform.

Cawthon says that this area of research must also identify the educational significance of alignment between standards, curriculum, and assessments. In the hearing-only, mixed, and deaf-only classrooms investigated in this study, teachers report their reading instruction to be moderately aligned to the standards. Perhaps moderate alignment to standards produces "good enough" results in terms of student achievement. Studies of simultaneous alignment with standards and related assessments will be needed to clarify the educational significance of these findings.

For more information, contact Cawthon at stephanie_cawthon@hotmail.com.

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WCER Highlights

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30 years of mathematics education research

Learning with understanding means more than being able to produce correct answers to routine problems.

Researchers and educators have learned a lot about the teaching and learning of mathematics in schools during the past 30+ years, much of it from the work of the emerging mathematics education research community. However, UW–Madison education professor emeritus Thomas A. Romberg says researchers and educators still have lots to learn about the teaching and learning of mathematics in the "messy" social environment of school classrooms.

For research to be productive and useful in any discipline, it must be conducted within a research community. Mathematics education is a relatively young academic field, and research on the teaching and learning of mathematics is even younger. A research community in mathematics education has only gradually begun to emerge in the past half century, and the process is still ongoing.

Reviewing mathematics education research, Romberg identifies 12 findings that distinguish what is known today from what was known in the 1960s. The first five come from research conducted by the National Center for Improving Student Learning and

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6 New NSF research centers

7 Breakfast, anyone?

FROM THE DIRECTOR

WCER welcomes two new Centers

Improving mathematics and science education has been at the core of WCER's work for decades. We continue that tradition with the introduction of two major new projects funded by the National Science Foundation. System-Wide Change for All Learners and Educators (SCALE) aims to reform math and science education, Grades pre-K through 12. It involves a UW–Madison partnership with the University of Pittsburgh and four school districts around the country. Another new project, the Center for the Integration of Research, Teaching and Learning (CIRTL), is part of a network of NSF Centers for Learning and Teaching. Together, these two centers address reform in grades kindergarten through college. They seek to develop a national science, engineering and mathematics faculty with teaching skills that will enable all college students to be scientifically literate.

I call my friend and colleague Tom Romberg "Mr. Math Education" because for decades he has made significant contributions to the nation's mathematics policy. In this issue Tom reviews his more than 30 years of research and discusses several things mathematics educators know today that they didn't know in the 1960s.

Systemic reform offers the possibility of fundamental improvement in American education. A question that remains is, how precisely can one measure student achievement resulting from systemic reform efforts? WCER researcher Norman Webb and colleagues recently identified three factors that can influence such measurement.

Also in this issue, UW–Madison education Professor Richard Halverson shares a story that illustrates how a home-grown program in a Chicago urban school succeeded in increasing the achievement of students of color and low-income students. The school principal launched a voluntary monthly "breakfast club" at which teachers gather to discuss their practice.

You're invited to spend time at our web site, www.wcer.wisc.edu. There you'll find research news beyond what we report in this newsletter.

Andy Porter

Achievement in Mathematics and Science on student learning with understanding, located at WCER.

1. Educators have underestimated students' capability to learn mathematics with understanding. Given the opportunity to explore a domain using a set of structured activities, *all students can learn important mathematics with understanding.*
2. Learning the concepts and skills in a mathematical domain requires that students be engaged in a rich set of structured activities over time. Specifically, students need an opportunity to investigate problems that encourage *mathematization*. By that is meant problems that are subject to measurement and quantification, that embody quantifiable change and variation, that involve specifiable uncertainty, and that involve our place in space and the spatial features of the world we inhabit and construct. In addition, problems should encourage the use of languages for expressing, communicating, reasoning, computing, abstracting, generalizing, and formalizing. Such problems require systematic forms of reasoning and argument to help establish the certainty, generality, consistency, and reliability of students' mathematical assertions.
3. Learning with understanding involves more than being able to produce correct answers to routine problems. Mathematics should be viewed as a human activity that reflects the work of mathematicians—finding out why given techniques work, inventing new techniques, and justifying assertions. Learning with understanding occurs when it becomes the focus of instruction, when students are given time to discover relationships and learn to use their knowledge, and when they reflect about their thinking and express their ideas. Doing mathematics cannot be viewed as a mechanical performance or an activity that solely involves following predetermined rules.
4. *Modeling* and *argumentation* are important aspects of mathematics instruction that foster learning with understanding. Modeling offers a way to represent phenomena in the world by means of a system of theoretically specified objects and relations. Modeling is critical in developing understanding in a domain. In classrooms, it is important to consider modeling as a cycle comprising model construction, exploration, and revision. Additionally, as students make conjectures, they need to learn to justify them. Thus, argumentation and standards of evidence, with an emphasis on promoting students' skills for generalization in mathematics, are critical.
5. Student learning should be seen as a product of situated involvement in a classroom culture. Learning with understanding is a product of interactions over time with teachers and other students in a classroom environment that encourages and values exploration of problem situations, modeling, and argumentation. The very nature of mathematics is defined communally, making participation by all not only a fundamental civil right, but also a critical prerequisite to the continued vitality of mathematics in the nation.

The very nature of mathematics is defined communally.

Romberg also points to four general findings from research on teaching. The reform approach to teaching represents a substantial departure from most teachers' prior experience, established beliefs, and present practice.

6. Teacher knowledge of student thinking is critical. Teachers need to listen and hear what students are saying as they conjecture and build arguments. Teachers also need to judge the quality of students' justifications and explanations in examining student work.
7. Teachers must understand the structure of mathematical domains. Knowledge of the network of relationships in a domain is critical when making decisions about student understanding and the sequence of instruction.
8. Rather than just cover the content in a textbook, teachers need to base instruction on the needs of their students. This finding follows directly from the previous two. If teachers know the level of their students' thinking, and understand how it fits within the structure of the domain of interest, then they can design appropriate instruction.
9. Professional development cannot be done well in isolation. Professionalism is the key to quality classroom instruction, but it can only be achieved if teachers join together to collaboratively undertake professional assistance.

Finally, one of the key aspects of teaching has always been monitoring students' progress. Mathematics teachers have traditionally done this by giving curriculum-based quizzes and tests, scoring and counting the number of correct answers on each, and periodically summarizing student performance in a letter grade. Unfortunately, this standard approach to assessment is not consistent with what educators now know about how students learn mathematics.

10. External tests have an effect on instruction in that teachers take classroom time to prepare students to take the test. However, such tests are not often well tailored to classroom instruction, nor are the results useful for monitoring growth over time.
11. Curriculum-based quizzes and tests tend to include items that are very similar to exercises in daily lessons and that reflect reproduction, definitions, or computations. Such instruments rarely contain items that require students to relate concepts or solve nonroutine problems.
12. Most mathematics teachers are aware that they acquire considerable informal evidence about their students, yet they rarely use such evidence in judging student progress. In fact, current data show that most mathematics teachers could benefit from professional development designed to help them learn how to make good use of their informal assessments.

Schools are social and political organizations that operate within a coherent set of traditions. Changing such organizations involves understanding and dealing with the partisan political and ideological perspectives on schooling that permeate our society.

Researchers and educators who hope to ground school procedures in the findings of research rather than in politics and ideology are likely to face either of two arguments: that the research is based on grossly unrealistic reductions of complex phenomena, or that it involves conflicts of value that cannot be resolved by evidence. In fact, Romberg believes it is naïve to believe that research findings can curtail partisan prejudices about schooling. Nevertheless, research is increasingly providing insights, understanding, and new approaches that lead to instruction that more effectively promotes student achievement.

For more information contact Romberg at tromberg@facstaff.wisc.edu.

Funding for research conducted by the National Center for Improving Student Learning and Achievement in Mathematics and Science (NCISLA) is provided by the U.S. Department of Education's Office of Educational Research and Improvement.

Romberg

Thomas A. Romberg is Sears Roebuck Foundation-Bascom Professor of Education at the University of Wisconsin–Madison. His research has analyzed young children's learning of initial mathematical concepts, methods of evaluating students and programs, and the integration of research on teaching, curriculum, and student thinking.

Romberg was a leader in the development of the National Council of Teachers of Mathematics (NCTM) Curriculum and Evaluation Standards for School Mathematics (1989). He is former director of WCER's National Center for Improving Student Learning and Achievement in Mathematics and Science. He offers these observations looking back over a career spanning more than 30 years.

Measuring effects of systemic initiatives

Do systemic initiatives improve student achievement? New measurement tools point toward answers.

Since public schools were first instituted in the United States, society's needs have changed. One way for education to keep up with a changing society is through piecemeal reform—that is, programs that offer improvement in specific areas of student achievement. Systemic education reform, on the other hand, offers the possibility of fundamental improvement in American education.

Demonstrating the effects of systemic education reform is difficult, given its complexity. However, a recent study by Norman Webb and WCER colleagues demonstrates analytic techniques that can be used to study the effects of systemic reform on growth in student learning over time.

Webb and colleagues analyzed data from the Texas Assessment of Academic Skills (TAAS) for Grades 3 through 8, focusing on the years 1994 through 2000. They then compared student achievement in Urban Systemic Initiative (USI)[1] districts with achievement in other Texas districts. Webb's analysis produced evidence of improvement in student learning in USI districts as compared with other districts. Specifically, the team found that:

- Students' TAAS scores in USI districts improved from 1994 to 2000 for all groups. Annual gain scores by Black and Latino students improved over time relative to those of White students.
- Overall, student achievement scores in USI districts began lower but improved faster than those in non-USI districts.
- Comparing USI and non-USI districts, one finds no difference in the rate at which gaps in achievement among students of different sociocultural backgrounds are narrowing.

Questions addressed

Webb's multidisciplinary research team worked for over a year to develop an analytic framework for studying the degree to which systemic reform contributes to improved student achievement and other outcomes.

For example, team member Dan Bolt examined changes in school mean scores on TAAS at a given grade level (e.g., Grade 5 in 1994, 1995, 1996, etc.). He believed this approach would more effectively control for teacher effects because the same

teachers are more likely to teach the same grade in successive years.

Meanwhile, Adam Gamoran used nearly all of the students in the database to estimate the growth intercepts and slopes. In this model, students with any two scores, even those whose scores are not for consecutive years, can be used to estimate the parameters.

Robert Meyer examined students' performance in a grade by considering their achievement from the year before. His analyses included students who had test scores for two consecutive years. The advantage of this approach is that improved student performance can be measured more precisely than if only one school year is considered.

All three approaches produced evidence that USI school districts had at least a small positive effect on student achievement. However, because of the lack of more specific information on USI activities, Webb cautions that the models could not definitively answer the question of whether the effects were directly related to USI participation.

The team did provide information to NSF that will enable NSF, its education constituencies, and education researchers to address the following questions:

- How can the data submitted to NSF by systemic initiatives be used to evaluate systemic reform?
- How does the precision of analysis depend on the qualities of student assessment data?
- What statistical models best fit the data linking systemic initiatives to student achievement?
- What are the lessons learned about the kinds of databases and analyses that are most effective for evaluating and understanding systemic reform?

Factors affecting precision

Webb and colleagues identified three general factors that can influence the precision of analyses of student achievement data in relation to systemic reform:

1. The extent to which teachers, schools, and districts participated in the systemic initiative over time. Classifying schools by their degree of participation in systemic initiatives would allow comparing school performance and would provide more precise information.
2. The types of students excluded from the testing and analyses, and
3. The standard error of measurement in the assessment instruments.

Achievement scores began lower but improved faster in USI districts.

Webb

Webb and colleagues hope that the analytic models they developed for this study will be widely applicable to other studies of large-scale reform. In fact, the most important contribution of the study, according to Webb, is its potential to inform the design of other evaluations of large-scale reform efforts and thus to increase the likelihood that data will be available in the future to more effectively measure the impact of such interventions on student learning.

Webb cautions that there is no one best model for analyzing the link between systemic initiatives and student achievement. Each model is based on specific assumptions made necessary by the limitations of available data or other constraints.

The research conducted by Webb and colleagues was supported by the National Science Foundation. For more information, contact Webb by e-mail at nlwebb@facstaff.wisc.edu or by telephone at (608) 263–4287.

1 NSF launched the USI program in 1994, applying lessons learned from its earlier State Systemic Initiative (SSI) program to the problems of inner-city school systems. The USI program was offered to major cities with the largest number of K–12 students living in poverty.

WCER hosts new NSF research centers

Mathieu

Millar

The National Science Foundation has awarded WCER $45 million over the next 5 years for two new mathematics and science education research centers, System-Wide Change for All Learners and Educators (SCALE) and the Center for the Integration of Research, Teaching and Learning (CIRTL).

SCALE aims to reform math and science education, Grades pre-K through 12. It involves a UW–Madison partnership with the University of Pittsburgh, the Los Angeles Unified School District, Denver Public Schools, Providence Public Schools, and the Madison (Wis.) Metropolitan School District. SCALE is bringing together mathematicians, scientists, social scientists, and education practitioners to improve the math and science achievement of all students at all grade levels in the four school districts. Students will be engaged in deep and authentic science and mathematics instructional experiences. Documentation of what works and information about how to construct such a partnership will be made available to policymakers and university and school leaders.

SCALE is directed by Terrence Millar, UW–Madison Professor of Mathematics and Associate Dean of the Physical Sciences, Graduate School.

The new Center for the Integration of Research, Teaching and Learning (CIRTL) promises to transform the UW–Madison into a working laboratory for helping graduate students and faculty develop teaching skills that match their research skills. Part of a network of NSF Centers for Learning and Teaching, CIRTL seeks to develop "a national science, engineering and mathematics faculty with teaching skills that will enable all college students to be scientifically literate, and that will promote a public better prepared to live in a high-tech world," says Robert Mathieu, a UW–Madison astronomy professor and the principal investigator of the new initiative.

CIRTL aims to help ensure that math and science are taught well not only to the select few undergraduates who go on to advanced degrees and careers in these fields, but also to students who will encounter only a minimum of science and math coursework. "All students should profit from improved instruction in undergraduate math and science, not just those pursuing a major," says Mathieu. "Students of color and women, for example, are less likely to take math and science courses as undergraduates. Even when they do, they are less likely to pursue further study in those disciplines."

CIRTL will aim for improved instruction in undergraduate math and science nationwide.

CIRTL will research and implement ways to increase the effectiveness of teaching approaches for all undergraduate students and thereby enhance success in science courses for diverse audiences.

CIRTL is a partnership of UW–Madison with Michigan State and Penn State Universities.

These projects join WCER's other recently funded NSF Center for Learning and Teaching, Diversity in Mathematics Education (DiME). DiME aims to develop and enhance the instructional workforce from kindergarten through graduate school. The program consists of three interrelated components: a doctoral/postdoctoral component; a teacher education component for teachers and instructional leaders; and a comprehensive research agenda. These components are integrated by a focus on the ideas of algebra and issues related to learners with diverse cultural, language, and cognitive backgrounds. DiME is directed by Walter Secada, UW–Madison professor of curriculum and instruction.

The centerpiece of DiME is its community of scholars, including the faculty, doctoral and master's degree students, participating teachers, and undergraduates who will engage in collective analysis of cases of mathematical learning and teaching using Web-based software. ■

Breakfast, anyone?

Home-grown professional development program succeeds

Halverson

Richard Halverson works to make the wisdom of successful leadership practice available to interested practitioners. Schools are very often mandated to change without principled opportunities to learn from successful peers. His current research with associate Colleen Capper aims to create multimedia cases of leadership practice that

- communicate the goals and resources required for leaders to engage in school change, and
- tell the story of how practitioners weave resources together to form coherent practice in their schools.

Practical wisdom is disclosed in the ways that school leaders set and solve problems in their schools. Halverson looks at locally-designed programs, which he refers to as artifacts, that provide a window into the practical wisdom of school leaders. In one case Halverson studied recently, one school's "breakfast club" showed how school leaders saw student achievement as a matter of improving the professional community in the school. Breakfast Club was one of the tools school leaders used to help develop and guide the emergent sense of professional community.

Teaching does not begin and end in the classroom. A teacher's experiences with other faculty members, with the school's leaders, and with its organizational structure all have a profound effect on the teacher's influence on students.

UW–Madison education professor Richard Halverson and colleagues documented the practices of public school principals from a variety of communities who succeeded in increasing the achievement of students of color and low-income students. They recently found a Chicago public elementary school that raised its student achievement scores after the school principal launched a voluntary monthly "breakfast club" at which teachers could gather to discuss their practice. Halverson was particularly interested in this innovative program as a model of *distributed leadership*—that is, leadership that emerges through the interaction of leaders and followers in the execution of both the everyday tasks of leadership (the micro tasks) and the school's overall instructional goals (the macro tasks).

Adams School is a Chicago neighborhood elementary school with about 1,200 students (largely African American) housed in two sites. Adams is widely recognized as a school with a well-articulated vision and a record of instructional change. Over the past 10 years, Adams has recorded demonstrable gains in student performance on high-stakes district and state assessment measures, and school leadership is given much of the credit for these improvements.

The breakfast club originated in 1995, when Adams School began hosting the monthly meetings to create professional community and provide an opportunity for teachers to review research on best instructional practices. Although several teachers at the school already kept abreast of current developments in the field, the school's professional development efforts rested largely on outside expertise, and they were too intermittent and variable in quality to have a long-lasting impact on student achievement scores.

In interviews with the school's administrative team, Halverson learned that:

- Faculty members did not want the breakfast club to be mandatory;
- The substance of the discussions needed to sell the program;
- The club should meet in the morning, so that teachers would be fresh and ready to entertain new ideas;
- The assigned readings should be kept short;
- Teachers should be permitted to select the readings and lead the discussions; and
- The readings should align with the school's instructional priorities and the teachers' classroom practice.

Innovation becomes institutionalized

The breakfast club was designed to acquaint teachers with relevant research in reading and writing, to help them "work smarter, not harder," in their efforts to help students improve their reading and writing skills. A persistent underlying goal was to improve student test scores in language arts on district standardized tests.

The Adams School leadership team recognized that improvement of student test scores might not result from a traditional professional development program using external consultants. Principal Brenda Williams realized that long-term gains in student test scores would more likely come when teachers had the opportunity to talk with one

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Fall 2002

Breakfast

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another about their teaching and that the monthly breakfast club would stimulate such conversations.

After two years, attendance at the breakfast club averaged about 75% of the school's teachers. The program was modified over time to add incentives for teachers to participate. For example, the principal encouraged teachers to lead a breakfast club discussion. Attendance increased as the veteran faculty members realized that they would be asked to lead discussions and therefore needed to find out what the breakfast club was about.

More than six years later, the breakfast club has become an institution at Adams School, and over the past four years, student achievement scores have risen 22%. Teachers and administrators credit the breakfast club as a key element in creating the kind of professional community necessary to develop a programmatic, cross-grade level approach to teaching reading and writing in the school.

The breakfast club resulted in significant change for Adams staff. It provided an opportunity for a school-wide professional community around language arts instruction. This professional community, in turn, was credited for student test score gains in reading and writing. The club also helped make teachers take ownership of their professional development. And the documentation of breakfast club practice has given Adams School leaders an opportunity to reflect on their practice, discern patterns, and make sense of instructional initiatives that originally evolved in practice.

Through a retelling of the breakfast club story, Halverson and colleagues have identified several of the guiding principles of leadership practice at Adams School, including:

- The importance of patience while waiting for a voluntary program to take hold;
- A commitment to considering research that is directly relevant to teacher practice; and
- A continued willingness to use collaborative design as a method for solving emergent school problems.

Halverson's current research is sponsored by the DeWitt Wallace-Reader's Digest Fund. With UW–Madison Education Professor Colleen Capper, Halverson is documenting and communicating leadership practices for students who traditionally struggle. For more information, contact Halverson at halverson@education.wisc.edu.

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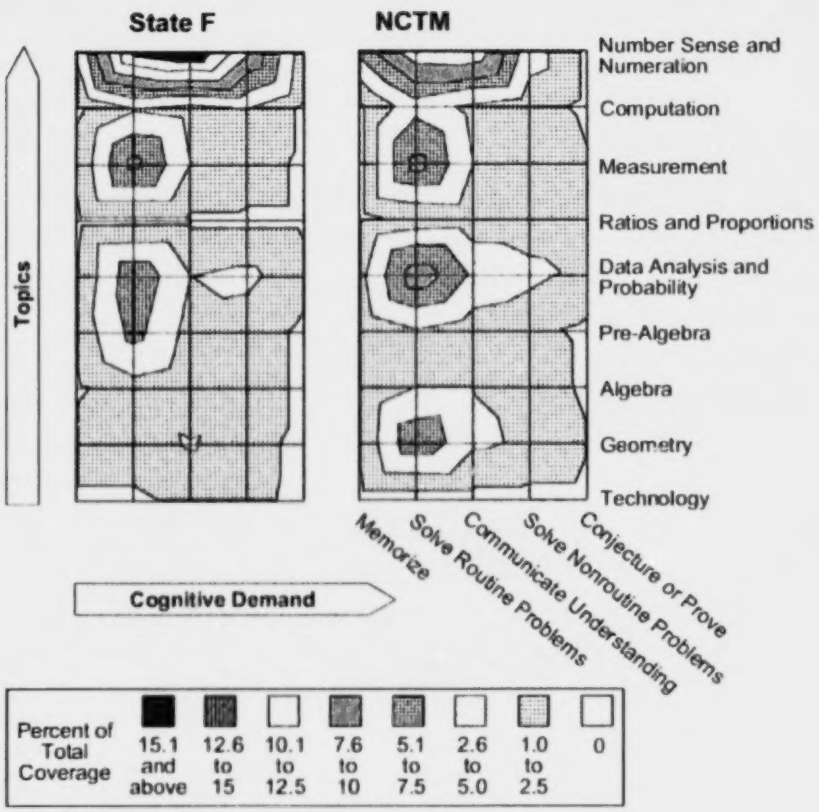
Measuring the content of instruction

Teachers get lots of advice and support from a variety of sources about what to teach. But do they really teach what is described in content standards? Do they teach what is in the textbook? Do they teach what is tested?

Classroom teachers are the ultimate arbiters of what is taught, and how. Regardless of what a state policy requires or what a district curriculum spells out, the classroom teacher ultimately decides how much time to allocate to particular school subjects, what topics to cover, when and in what order, to what standards of achievement, and to which students. Collectively, teachers' decisions, and their implementation, define the content of instruction.



Uniform content language allows one to compare alignment between states and to national standards.

Knowing what teachers actually teach is important to educators and policymakers who need to determine whether and to what degree there is overlap (or *alignment*) between what is taught, what is tested, and what national, state, and local content standards prescribe.

Tools for measuring content and alignment

For the past 25 years, Andrew Porter and his colleagues have studied teachers' content decision-making in mathematics and science. He has developed three kinds of tools for measuring content and alignment:

1. Teacher surveys describing the content of instruction;
2. Content analyses of instructional materials, including assessments; and
3. Indices of alignment between instructional content, instructional materials, and standards.

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5 Putting case study results into context

6 Developing algebraic reasoning in elementary grades

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FROM THE DIRECTOR

Stimulating and measuring learning

For many years researchers have studied the development of children's algebraic reasoning and the nature of classroom interactions that support that development. Tom Carpenter and colleagues have found that, if young children are given the opportunity, they can make their own meaningful insights into the underlying structure and properties of arithmetic operations. They can also construct ways of representing them and justifying them.

Just as academic skills are crucial to students' success, so are academic enablers. Academic enablers include motivation, interpersonal skills, and engagement. Steve Elliott and Jim DiPerna maintain that these enabling attitudes should be taught explicitly to optimize students' learning.

Teachers are learners, too. Teacher professional change occurs through partnerships between university researchers and mathematics and science teachers. Adam Gamoran and colleagues recently explored how schools encouraged teacher collaboration through a combination of two elements: organic management and distributed leadership.

And finally, this issue contains an introduction to a measurement tool I developed with colleagues that can help educators develop content standards. The 'content matrix' aims to help educators make difficult choices about curriculum, instruction, and assessment. Policymakers can use the tool to build standards that clearly define what is to be taught and what is not to be taught.

For more information visit the WCER web site at www.wcer.wisc.edu

Andy Porter

The power of these tools lies in the uniform language they use for describing content. It is this uniform language that makes it possible to build indices of alignment.

The language developed by Porter and colleagues consists of uniform descriptors of topics (*level of coverage*) and student expectations (*categories of cognitive demand*). The level of coverage and the categories of cognitive demand form the columns and rows of a two-dimensional matrix. The content of instruction is described at the intersection between topic and cognitive demand (See Table 1, *Content Matrix*).

The values placed in each cell of the matrix reflect data gathered from teacher surveys or from content analyses of instructional materials. For example, the surveys ask teachers to indicate, for the past school year,

1. the amount of time they devoted to each topic (the level of coverage), and
2. for each topic, the relative emphasis they gave to each student expectation (category of cognitive demand).

Porter and colleagues then analyze the results from surveys and content analyses to produce topographical maps that graphically display the content of instruction.

Porter's content matrix can also be used as a tool for developing content standards. The power of the content matrix in this context is that it facilitates clarity in making hard choices, Porter says. State content standards—and even national-level standards, like the mathematics standards developed by the National Council of Teachers of Mathematics (NCTM)—tend to include much more content than can be taught in depth. Educators and policymakers can use the content matrix (and the topographical maps displaying the content) to build standards that clearly define not only what is to be taught but also what is not to be taught.

Porter's method of measuring the content of instruction and alignment differs from other approaches in two ways:

1. The tools allow independent and replicable descriptions of the content of instructional practice and instructional materials. The uniform language for measuring content ensures descriptions at a consistent level of depth and specificity.
2. The uniform language allows alignment to be measured across a large number of instructional materials and instructional practices. See Fig. 1, *Vertical and horizontal alignment*.

Using the tools to study alignment

Most approaches to alignment of assessments with standards start with a particular state's standards and ask: To what extent does the content in those standards appear on the test? Such analyses are unique to each state. They don't allow comparisons between states or comparisons between state and other professional standards. But the uniform content language developed by Porter and colleagues allows one to compare alignment between states, and to national standards like the NCTM standards.

In a study done at the American Institutes for Research, Rebecca Herman and Laura Desimone recently used Porter's tools to study the alignment of standards with assessments in four states. Their data showed that the assessment of each state was no more aligned to its own standards than to the standards of the other states or to those of NCTM.

Porter says that perhaps the state standards are not sufficiently specific to allow an assessment to be tightly aligned with them. But he says a more

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Topic	Category of cognitive demand				
	Memorize	Perform procedures	Communicate understanding	Solve nonroutine problems	Conjecture/ generalize/prove
Multiple-step equations					
Inequalities					
Linear equations					
Lines/slope and intercept					
Operations on polynomials					
Quadratic equations					

Table 1. Content matrix

likely possibility is that states have much more work to do to bring their assessments into alignment with their standards. This finding is one about which U.S. Department of Education officials are expressing concern, Porter says.

The tools described here are used for science as well as mathematics. Some early work has also been done in the areas of reading and language arts and social studies. Following are examples of how the tools can be used to describe instructional practices, instructional materials, and alignment.

Describing instructional practices

Good measures of the content of instruction can serve

1. to define the process of teacher decision making in reaction to the various messages that teachers receive about what should be taught,
2. to describe the implemented curriculum or to measure the degree of implementation of a new curriculum,
3. to validate transcript studies, and
4. to provide the basis for powerful professional development experiences.

With regard to professional development, Andrew Porter and colleagues are using their measures of the content of instruction as the core of a new program on teachers' instructional practices, with funding from the National Science Foundation. The program begins by having teachers complete surveys describing the content of their instruction. Porter and colleagues then analyze the results and produce graphic displays that are returned to the teachers. Finally, teacher teams use the data to answer the following questions:

1. Is the content of our instruction what we want it to be? Is it aligned with our tests and content standards?
2. Are the differences in what teachers are teaching appropriate?
3. Do the prerequisite courses provide the content needed for effective grade-to-grade articulation?

In research, indices of alignment between the content of instruction and a student achievement test can be used as a control variable in studies of the effects of pedagogical practices on student achievement gains. An index of alignment can also be used as a descriptive variable in assessing the coherence of a state's or district's curriculum policy system.

For more information see Porter's page at the WCER web site, www.wcer.wisc.edu.

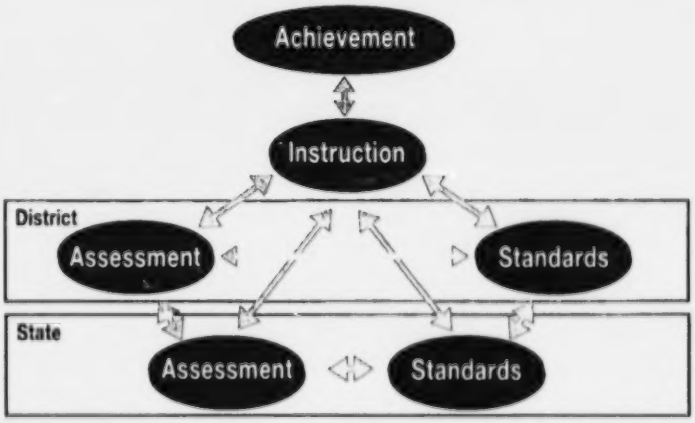

Figure 1. Vertical and horizontal alignment

"Academic enablers" critical to student success

Elliott

DiPerna

Malecki

Academic skills are, and should be, the primary focus of instruction in schools. However, recent research suggests that student achievement also depends on *academic enablers*. Academic enablers are attitudes and behaviors that allow a student to participate in, and ultimately benefit from, academic instruction in the classroom. These enablers include motivation, interpersonal skills, engagement, and study skills.

UW–Madison educational psychology professor Stephen N. Elliott and WCER researcher James DiPerna maintain that enabling skills and attitudes can, and should, be taught explicitly to optimize students' learning. Their recent research finds that students' prior achievement and interpersonal skills influence motivation, which, in turn, influences study skills and engagement to promote achievement.

Study skills begin to assume a significant role in promoting achievement as students advance through the elementary school curriculum. Beginning in the intermediate grade levels, there is a shift in curricular emphasis from learning to read to reading to learn. The curriculum increasingly emphasizes content acquisition over skill development. Thus study skills assume a more significant role in the learning process.

In a related study, Elliott and former student Christine Malecki (now a faculty member at Northern Illinois University) determined that interpersonal skills are a significant predictor of academic competence (the skills, attitudes, and behaviors that contribute to success); and academic competence, in turn, is a significant predictor of achievement. Elliott and Malecki concluded that social skills have a significant predictive relationship with academic outcomes.

There is more evidence to support the relationships between academic achievement and students' competence. This evidence comes from research using DiPerna and Elliott's Academic Competence Evaluation Scales (ACES). DiPerna and Elliott have found that academic enablers measured by ACES affect student grades and performance on standardized tests of achievement.

There are practical reasons for measuring academic enablers. School psychologists and other education professionals need a framework for thinking about assessment, intervention, and prevention services so they can help students receive optimal benefit from their education. Elliott points out that failing to address academic enablers may result in assessment and intervention plans that overlook key factors contributing to a student's academic difficulty.

Prior achievement is a strong predictor of current achievement (knowledge and skills). Likewise, current achievement is a strong predictor of future achievement. For students experiencing academic difficulty, chances for future academic success may be limited unless an educator intervenes to address specific problems. Delaying intervention to allow a student's skills to mature and possibly catch up to grade-level expectations may not be a wise choice, even for students at the primary level.

The DiPerna and Elliott study suggests that students' motivation, engagement, study skills, and interpersonal skills should be considered when designing assessments for students experiencing academic difficulty. For example, a practitioner who designs an assessment focusing exclusively on motivation and current academic skills may be overlooking important things that contribute to the student's academic performance (e.g., study skills, interpersonal skills). This omission could result in identifying the wrong cause of the academic difficulty. The educator also may develop an intervention that fails to address the true problem (e.g., difficulty getting along with others in class, which decreases a student's motivation to succeed in the classroom).

Since academic enablers contribute in meaningful ways to academic achievement, and the primary responsibility of schools and education professionals is to promote achievement, schools and educators need to consider what is being done to promote the development of academic enablers for all students.

For more information, contact DiPerna at jdiperna@facstaff.wisc.edu or Elliott at snelliot@facstaff.wisc.edu.

Research funding was provided by the Northeast Foundation for Children and the Fitchburg (Mass.) Public Schools.

Information for this article originally appeared in *School Psychology Review*, 2002, vol. 31, issue 3, pp. 298–312.

Putting case study results into context

Researchers studying schools as organizations often confront a tension between the need to achieve an in-depth understanding of local organizational conditions, on the one hand, and the need to know whether the knowledge gained from such case studies can be generalized more broadly, on the other.

Drawing on a national database helped WCER researchers Adam Gamoran and Tona Williams say more about how a school's organizational context can support teachers' efforts to improve their teaching.

Gamoran and Williams and their colleagues were concerned with how schools and school districts support teachers' efforts to improve their teaching. In their examination of cases of teacher change in Wisconsin and Massachusetts, they discovered that leadership and autonomy were important aspects of schools' organizational contexts that supported change. The question then became: Was the level of autonomy and leadership they found in these cases really significant, in a national context?

In two districts, Gamoran and Williams and their research team interviewed teachers, surveyed them, and observed them in professional development seminars. In these districts, teacher change occurred through partnerships between university researchers and mathematics and science teachers as they developed classroom practices of "teaching for understanding"—that is, attending to student thinking, focusing on powerful scientific and mathematical ideas and practices, and developing equitable classroom learning communities. Gamoran and Williams' study explored how the organizational context of each site affected collaboration to teach for understanding.

Gamoran and Williams found that the sites encouraged collaboration through a combination of two elements: organic management and distributed leadership. *Organic management* means that leaders respond to needs that emerge from teaching, instead of simply allocating resources in a bureaucratic manner. *Distributed leadership* takes advantage of expertise at all organizational levels and allows both teachers and administrators to make important decisions, instead of centralizing authority. These two practices enabled the schools to adapt to changes in teachers' thinking and classroom activities in ways that would not have been possible had the schools relied solely on more traditional school organization.

The study also found that administrators who adopted a style of organic management that responded to teacher initiatives faced two important tradeoffs: (a) when teachers were more autonomous, it was more difficult to establish a coherent direction for the school, and (b) when teachers provided their own leadership, it was more challenging to ensure the completion of routine administrative tasks. Across the sites, administrators adopted a range of strategies to address these tradeoffs.

In the cases studied, leadership in support of teacher change tended to focus either on establishing a compelling district vision that supported teaching for understanding or on providing teachers with the autonomy to develop their own visions. Each approach appeared to be effective. Gamoran and Williams also found that leaders most effectively supported change when they distributed authority beyond conventional leadership positions, while also finding ways to manage the necessary logistical details of professional development and other teacher improvement processes.

Comparison to national averages

Analysis of only two districts could not give Gamoran and Williams the perspective necessary to interpret the broader significance of their findings. Without knowledge of national averages for the factors they studied, Gamoran and Williams would have been limited to comparing the cases to one another and guessing about their overall importance. Therefore, when designing their survey, they drew most of the questions from the Schools and Staffing Survey (SASS) of the National Center for Education Statistics (NCES). This allowed them to compare their findings with national data. When applied systematically, such national-sample data sets can bridge macro-/micro-level, and qualitative/quantitative, gaps in education research.

In the case studies, Gamoran and Williams and their colleagues found that leaders in the Wisconsin site emphasized providing teachers the autonomy to establish their own visions, whereas leaders in the Massachusetts site developed a district-wide vision to overcome a prior lack of coherence among teachers and schools. In survey responses, compared to national averages, teachers in both states

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Gamoran

Williams

Developing algebraic reasoning in the elementary school

Effective teachers find instructional content that makes students' implicit knowledge explicit.

Children in elementary school mathematics classes are often able to do more than the current curriculum challenges them to do. For example, they can learn to generalize and to express their generalizations accurately using natural language and symbols. When they are given the opportunity, they learn to adapt their thinking about arithmetic so that it provides a stronger foundation for making the often difficult transition to learning algebra.

School mathematics curricula in the U.S. have traditionally separated arithmetic and algebra. This historic separation has deprived students of powerful schemes for thinking about mathematics in the early grades, says UW–Madison education professor Thomas Carpenter. Carpenter directs the National Center for Improving Student Learning and Achievement in Mathematics and Science (NCISLA).

Separating arithmetic and algebra makes it more difficult for students to learn algebra in the later grades. But simply pushing the current high school algebra curriculum down into the elementary school won't work. A broader conception of algebra emphasizes the development of algebraic thinking, rather than just skilled use of algebraic procedures. Students in the elementary grades can begin to engage in meaningful discussion about mathematical proof and make significant progress in understanding its nature and importance. Development of their algebraic reasoning is reflected in their ability to generate, represent, and justify generalizations about fundamental properties of arithmetic.

In their research, NCISLA researchers Tom Carpenter, Linda Levi, Patricia Berman, Jae-Meen Baek, Julie Koehler, and Margaret Pligge have found that when students working with mathematics make generalizations and represent them for their classmates, they articulate unifying ideas that make important mathematical relationships explicit. Underlying this pedagogical approach is a conception of mathematical understanding as constructing mathematical relationships and reflecting on and articulating those relationships.

For the last 5 years, Carpenter and his colleagues have worked intensively with a group of teachers to study the development of students' algebraic reasoning in the elementary grades and to construct instructional approaches that support that development. Their work with 100 elementary school teachers and their students in Grades 1 through 6, including in-depth studies of three classes, has provided the following insights.

A window on student thinking

When students make generalizations about properties of numbers or operations, they make explicit their mathematical thinking. Generalizations provide the class with fundamental mathematical propositions for examination, while also opening up students' thinking for analysis and discussion. Although students often have a great deal of implicit knowledge of properties of arithmetic operations, they typically have not explicitly examined generalizations about properties of numbers and operations or thought systematically about them. The trick for educators, says Carpenter, is to find an instructional context in which students' implicit knowledge can be made explicit. Discussion of appropriately selected true and false number sentences provides such a context.

As an example: In one class exercise, children were asked whether it is true that 0 + 5,869 = 5,869. After some discussion, the group came up with the generalization: "Zero added with another number equals that number." They also came up with the following generalizations: "Zero subtracted from another number equals that number," and "Any number minus the same number equals zero." In addition, one student came up with several related generalizations about multiplication.

True, false, and open number sentences provided a context in which these students could

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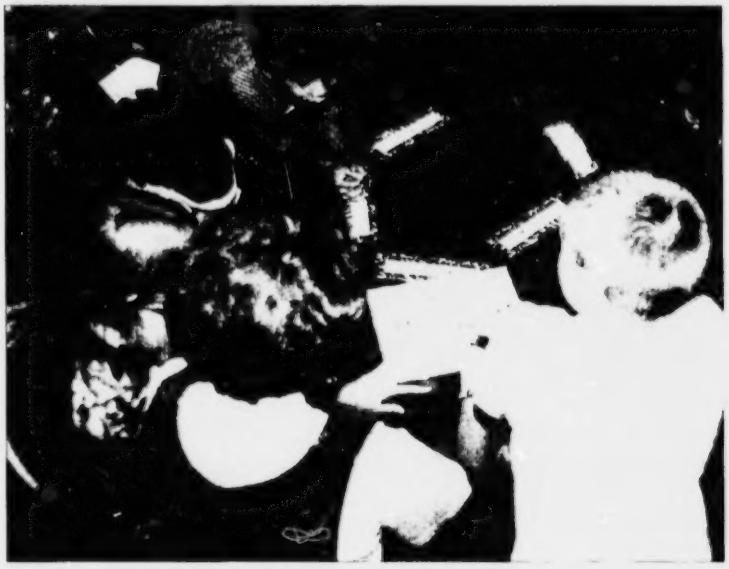
begin to convert their implicit understandings into explicit generalizations. Number sentences generated by the teacher provided the initial basis for drawing out generalizations. But once the classes started to talk about generalizations, making generalizations became a class norm, and students would propose generalizations on their own.

In most of the classes studied, students would write generalizations on sheets of paper and post them in some location in the room. When generalizations were difficult to state clearly in natural language, the students would use symbols to express the generalizations precisely. For example, students represented a conjecture about changing the order of numbers in addition as follows: For all numbers a and b, $a + b = b + a$.



A teacher records students' generalizations.

Conclusions

Elementary school students can learn to adapt their thinking about arithmetic so that it is more algebraic in nature. They can learn that the equal sign represents a relation, not a sign to carry out a calculation. They can learn to generalize and to express their generalizations accurately using natural language and symbols. Although not all students in the elementary grades will master mathematical proof, they can begin to engage in meaningful discussion about proof and make significant progress in understanding its nature and importance.

Understanding justification and proof takes years to develop. Although many sixth-grade students in a NCISLA case study were not yet able to generate proofs by themselves, most of them learned to recognize the limits of examples and the value of general arguments. They engaged in discussions of the nature of proof that made explicit important issues that most students never encounter at any point in their education. These experiences could provide a foundation for deepening these students' understanding of proof in the future.

"One of the things that was striking about the classes we worked in was that the students were engaged in sense making," says Linda Levi. "They thought that mathematics should make sense and that they could make sense of it. Students persisted for extended periods of time working on a problem, because they thought they should be able to figure it out."

All students benefit by engaging in the kinds of interactions that are required to make generalizations explicit, represent them accurately with natural language and symbols, and demonstrate that they are valid for all numbers. Learning to use precise language and communicate about mathematical ideas addresses not only an important goal of the mathematics curriculum, but also important issues of equity. The best students have always figured out how to derive generalizations and thereby make mathematics easier to learn and apply. Helping students make generalizations explicit gives *all* students access to powerful ideas of mathematics.

A new book is available, *Thinking Mathematically: Integrating Arithmetic & Algebra in Elementary School*, by Carpenter, Levi, and Megan Loef Franke (Heinemann, 2003).

For more information about research into mathematics education, see the NCISLA Web site at http://www.wcer.wisc.edu/NCISLA/.

Funding for NCISLA projects is provided by the National Science Foundation and the U.S. Department of Education's Institute of Education Sciences (formerly the Office of Educational Research and Improvement).

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Carpenter

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Results

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reported higher levels of classroom autonomy and influence over school policy, which suggests the presence of distributed leadership. Teachers in the Wisconsin district reported a great deal of influence over the selection of instructional materials and teaching techniques, and an extraordinary level of influence over school policy. Massachusetts teachers, in contrast, scored lower on autonomy and influence. This pattern was consistent with interview responses from teachers, principals, and district staff that indicated the prominence of distributed leadership in the Wisconsin site, in particular.

At the same time, the Wisconsin and Massachusetts teachers both scored *below* national norms in the degree to which they perceived administrative personnel (and especially principals) as offering strong leadership and support. These findings, which suggest a lack of focus on centralized, top-down leadership, are consistent with Gamoran and Williams' interpretation that opening opportunities for teacher autonomy means reducing principals' vision-setting role.

Though Gamoran and Williams' study centered on developing an in-depth understanding of a small number of cases, the process of comparing some of their data against national norms made their analysis more robust.

For more information, contact Gamoran at gamoran@ssc.wisc.edu or Williams at twilliam@ssc.wisc.edu.

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